Results of the 2018 Test Year Modeling Analysis

Prepared on behalf of Transmission Developers Inc. for settlement purposes in Case 10-T-0139 by London Economics International LLC

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LONDON ECONOMICS

1 Executive summary

London Economics International LLC ("LEI") was retained by Transmission Developers Inc. ("TDI") to analyze the power market impacts created by its proposed transmission project, the Champlain-Hudson Power Express ("CHPE").

On July 16, 2010, LEI filed its report in the Article VII application for CHPE, documenting the forecasted impact of the proposed CHPE project on the New York power markets, focusing on energy and capacity market savings as well as emissions reductions. LEI's study projected energy benefits ranging from $684 million to $904 million per year on average over a ten-year modeling timeframe under the Baseline, with a ten-year average expectation of $813.5 million per annum for the New York Control Area ("NYCA").

In addition, the LEI report detailed sensitivity analysis on key assumptions. Sensitivities were conducted individually for several key inputs, in order to gauge the potential direction and magnitude of impacts of key, external drivers, on the benefits estimated; but the alternative outlooks for input assumptions were not combined into a single case. For reference, Figure 10 in the Appendix summarizes the annual energy market benefits under the Baseline and sensitivities.

1.1 At a settlement conference in December 2010, settlement parties discussed various changes in market conditions

The LEI analysis was conducted in late 2009. Given the more than 12-month timeframe from assumption development, it is not surprising that some of the inputs have become dated. For example, the New York ISO ("NYISO") has updated it load forecast, taking into account the effects of the economic recession. In addition, shale gas discoveries have increased the downward pressure on gas prices, even through the long term, moving gas market forwards down by 20% since early 2010. In addition, infrastructure development has continued to evolve from initial plans in early 2009.

1.2 DPS Staff prepared their own, independent one-year modeling analysis of the CHPE using GE MAPS and a variant of the State Energy Plan 2009 input database

DPS Staff's modeling shows that NYCA can expect energy benefits of $405 to $720 million per year, with millions of dollars of incremental benefits for adjoining control areas of PJM and ISO-NE.

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DPS staff's modeling analysis was conducted for single test year (2018) using a GE MAPS database that had been compiled by ICF Consulting as part of their calibration work for the State Energy Plan in 2009 ("SEP 2009"). The GE MAPS model was run at the nodal level, representing all transmission elements. GE MAPS was run for the Eastern interconnect (including the markets of New York, New England, PJM, MISO, and SERC); however, staff focused on the effects of CHPE on the three Eastern markets of NYISO, ISO-NE, and PJM.

DPS staff had updated the GE MAPS input database with the NYISO's 2010 demand forecast. DPS staff had investigated updating gas prices (but concluded that the SEP 2009 forecast produced delivered gas prices that were only 7-10% higher than the delivered gas price outlook based on current Henry Hub projections from Energy Information Administration's *Annual Energy Outlook 2011 ("AEO2011")* early release, once adjusted for transportation costs). DPS staff also made adjustments for known new resources, like the addition of Bayonne plant and Empire Generating plant. The primary factor affecting the DPS staff modeling results was the calibration of hurdle rates which impacted the level of inter-regional transactions and therefore the relative dissipation of location based marginal price ("LBMP") impacts outside the NYCA. We understand that the DPS staff tested alternative hurdle rates to what had been developed by ICF Consulting originally under the SEP 2009 calibration process, after examining modeled flows between NYCA and PJM, and NYCA and New England, and comparing those modeled flows to actual (historical) levels of interchanges between ISOs.

DPS staff modeled CHPE as a dispatchable resource with a low marginal cost. Based on their modeling, the energy on CHPE was flowing with a utilization rate of approximately 80%.

1.3 Convergence of LEI and DPS modeling efforts

At the January 11, 2011 settlement conference, LEI agreed to create a "test year" forecast analysis in POOLMod using a combined set of assumptions that better aligned with the assumptions employed by the DPS staff and current expectations for the future.

Given the limited time allowed, LEI updated its analysis only for 2018 using comparable assumptions based on input databases that had been created for the sensitivity analysis that was conducted for the July 2010 LEI report. Specifically, LEI used the 2010 Gold Book base case and the fuel price inputs from the "low fuel price" sensitivity case. Furthermore, LEI updated the supply mix to include the latest information on announced retirements and new supply additions (please see Section 2.3 for further details). To develop a range of benefits, LEI simulated two different utilization rates for the CHPE, specifically 75% and 90%, which is comparable to the resulting capacity factor of 80% in the DPS Staff modeling.

1.3.1 LBMP Impacts/Ratepayer Benefits

Under the Base Case (without CHPE), forecast price levels for 2018 decline by a range of 11% (Upstate New York region) to over 30% (e.g., C-LHV region) as compared to the Base Case due to lower fuel prices and lower demand as well as the changes in supply mix. Projected ratepayer benefits decline proportionally for the 2018 test year modeling. Depending on the utilization rates for the CHPE, the 2018 test year modeling projects NYCA-wide benefits of $554

to $655 million for the NYCA, with $427 to $501 million of that total attributed to NYC region. These ratepayer benefit estimates from the 2018 test year analysis are 26% to 38% lower than the baseline presented in the original study (July 2010 LEI Report).

The results of the LEI analysis for 2018 test year are generally corroborative with DPS Staff's modeling. DPS Staff's modeling results project ratepayer benefits for the NYCA in 2018 of approximately $405 million to $720 million. Under the 90% utilization rate for the CHPE, LEI's 2018 test year modeling projects NYCA benefits totaling $654 million; and, under the 75% utilization rate, the 2018 energy market benefits decline to $554 million for the NYCA.

Figure 1. Comparison of ratepayer benefits of CHPE project for NYCA in 2018 ($ millions)

	Ratepayer benefit ($ million)
NYDPS Staff estimate	$405 - $720
Updated ratepayer benefit with CHPE @ 75% - 90%	$554 - $654

Source: DPS Staff analysis (January 14, 2011) and LEI 2018 test year analysis

As shown in the figure above, the LEI's range of ratepayer benefits for the 2018 test year overlaps with DPS Staff's estimates to a large extent. However, the results are not exactly the same due to differences in modeling tools and differences in other assumptions. For example, DPS Staff analysis is based on GE MAPS whereas LEI analysis is based on POOLMod. In addition, DPS Staff analysis is based on one single run of 8,760 hours whereas LEI analysis is based on twenty iterations of different maintenance schedule profiles for the 8,760 hours. In addition, in POOLMod, certain hydroelectric resources are allowed to shadow price, mimicking bidding behavior observed in markets; while, in GE MAPS, all hydroelectric resources are treated as load modifiers. In terms of modeling inputs, DPS Staff and LEI have used different import and export schedules, different CO_2 assumptions, and possibly different assumptions on resource mix.

1.3.2 Environmental impacts

LEI forecasts emission reductions in the range of 454 - 571 tons for SO_2, 952 – 1,114 tons for NO_x and 2.5 – 2.9 million tons for CO_2 under the 2018 test year for the NYCA. These 2018 test year modeling results are consistent with the environmental impacts estimated in DPS Staff's projections. As shown in the table below, DPS Staff's emissions reductions for 2018 are projected in the range of 499 tons to 828 tons for SO_2, 748 tons to 1,432 tons for NO_x, and 1.5 million tons to 2.2 million tons for CO_2. In comparison, LEI's 2018 test year modeling forecasts emission reductions of SO_2 in the range of 454 - 571 tons, NO_x emissions reductions in the range of 952 tons to 1,114 tons and CO_2 emissions reductions in the range of 2.5 – 2.9 million tons.

Figure 2. Comparison of emissions reductions of CHPE project for NYCA in 2018

Emissions reductions	SO_2 (tons)	NOx (tons)	CO_2 (tons)
NYDPS Staff estimate	499 - 828	748 - 1,432	1.5 - 2.2 million
Updated ratepayer benefit with CHPE @ 75%- 90%	454 - 571	952-1,114	2.5 - 2.9 million

Source: DPS Staff analysis and LEI 2018 test year modeling analysis

1.3.3 CHPE also produces energy market (ratepayer) benefits to markets outside the NYCA

DPS staff also reported benefits to external control areas. LEI did not have the time to compile detailed tabular summaries of the ratepayer benefits, but, based on our preliminary review, LEI expects that ISO-NE ratepayers will see reduced energy prices and therefore receive ratepayer benefits system-wide in the range of $20 to $25 million per year. We have not modeled the PJM market in a fashion that would allow us to extract price impacts. However, we do expect that there would be pride reductions in PJM as well, which would create meaningful ratepayer benefits for PJM constituents.

1.3.4 Concluding remarks

Due to difference in modeling tools and modeling methods,[1] it is impossible to generate exactly the same estimate of ratepayer benefit and emission reduction of the CHPE project for NYCA. However, by comparing the range of estimates using comparable assumptions of fuel price and demand, we observe that the range of results of the two, independent analyses overlaps significantly, providing confidence that the CHPE is likely to produce substantial benefits to New York ratepayers as well as ratepayers in neighboring control areas.

[1] For example, DPS Staff analysis is based on GE MAPS whereas LEI analysis is based on POOLMod. In addition, DPS Staff analysis is based on one single run whereas LEI analysis is based on twenty iterations of different maintenance schedule profiles.

2 Change in input assumptions

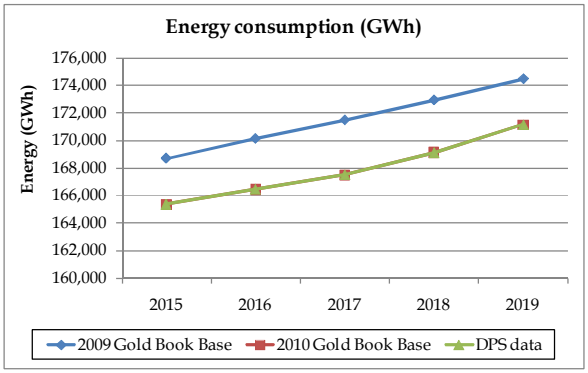
Within the limited allotted time to complete the 2018 test case, LEI attempted to update key modeling assumptions to be consistent with the latest market trends and the assumptions used in the DPS Staff's analysis for the 2018 test year analysis.

2.1 Demand

The Baseline demand assumption of the July 2010 LEI report was based on the Base Case demand in the 2009 Gold Book published by the NYISO, which was the latest forecast available when the model was developed. In this modeling update, LEI has used the demand in the 2010 Gold Book in the updated Base Case. As shown in Figure 3, demand used in DPS Staff analysis is consistent with the projected energy consumption as published in 2010 Gold Book.

In general, the 2010 Gold Book has a lower projected annual total energy when compared to the 2009 Gold Book for 2018 – approximately 1% to 4% lower, depending on sub-region - as summarized in the figure below. Peak demand in the 2010 Gold Book Base Case is about 2% lower for all the regions as compared to the 2009 Gold Book Base Case for 2018 forecast year, except for UPNY, where peak demand is 1% higher in the 2010 Gold Book Base Case.

Figure 3. Comparison of projected energy consumption



Source: 2009 NYISO Gold Book, 2010 NYISO Gold Book and NYDPS Staff analysis

Figure 4. Projected annual energy and peak demand under 2009 Gold Book Base Case and 2010 Gold Book Base Case, 2018

		NYCA	UPNY	C-LHV	NYC	LI
Energy (GWh)	2009 Gold Book Base	172,939	58,866	32,948	56,510	24,615
	2010 Gold Book Base	169,132	56,879	32,721	55,886	23,646
	Change	*-2%*	*-3%*	*-1%*	*-1%*	*-4%*
Peak (MW)	2009 Gold Book Base	35,450	9,816	7,055	12,775	5,804
	2010 Gold Book Base	34,673	9,878	6,940	12,298	5,557
	Change	*-2%*	*1%*	*-2%*	*-4%*	*-4%*

Source: NYISO

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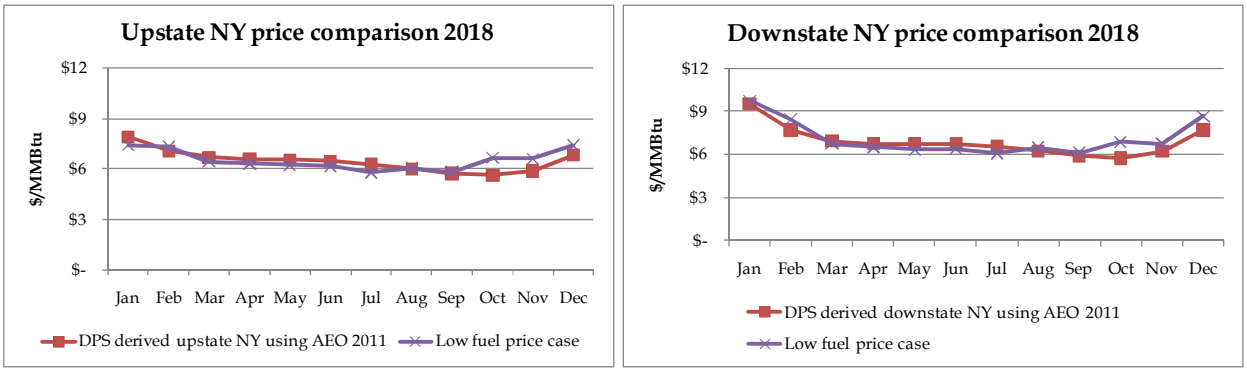
2.2 Fuel prices

In the 2018 test year modeling, LEI used the low fuel price assumptions, which are about 31% lower than the assumptions used in the Base Case for the July 2010 LEI report. The "low fuel price" assumptions set is generally consistent with the current fuel price outlook, as well as with the DPS Staff's assumptions. For example, LEI's "low fuel price" case assumes $6.5/MMBtu delivered gas (in nominal dollar terms) to UPNY generators and $7.2/MMBtu delivered has price for NYC and LI on an annual average basis.[2] For reference purposes, DPS Staff's projected delivered gas prices range from $6.5/MMBtu (Upstate) to $6.9/MMBtu (Downstate) on annual average basis, in line with EIA's *AEO 2011* (early release).

Figure 5. Comparison of delivered natural gas price projections for 2018 from LEI's "low fuel price" case with AEO 2011 (nominal $/MMbtu)



Source: DPS Staff derived gas price and LEI

2.3 Supply mix

In updating the supply mix, LEI modified and updated the generation data in its original database, to be consistent with recent developments. For example, we incorporated more accurately the newly operating Empire plant and included in the NYC resource mix, the currently under construction Bayonne plant. In addition, resource retirements were modified to included announcements for closure and long-term outage of approximately 500 MW of capacity in UPNY and NYC regions that we had not previously modeled in the original baseline. Based on market economic dynamics and the inclusion of the Bayonne project, we also modified the generic new entry schedule and removed 350 MW of generic peaking capacity that had been included in NYC region by 2018 for resource adequacy reasons in the original Baseline. The figure below summarizes the supply mix changes.

[2] Using the current forward price for Henry Hub the short-term from NYMEX, then escalating in the longer term using 2011 Energy Information Agency ("EIA") 2011 Annual Energy Outlook ("AEO") forecast released in December 2010, the projected Henry Hub commodity price is around $6/MMBtu in 2018 (in nominal dollar terms). There is a substantial transportation basis to the New York area that must be included on top of the Henry Hub commodity price, in order to estimate delivered gas prices for New York area generators.

Figure 6. Supply changes for the 2018 test year analysis

Announced capacity additions		
Plant	Zone	DNC
Bayonne Energy	NYC	513
Fairfield Wind Project	WST	74
Subtotal		***587***
Announced retirements		
Plant	**Zone**	**DNC**
North East Cogen	WST	88
Project Orange Associate LP	WST	94
Astoria GT 5, 7, 8, 10-13	NYC	128
Subtotal		***310***
Generic new entry adjustments		
Zone		**DNC**
NYC[3]		350
Subtotal		***350***
Other adjustments		
Plant	**Zone**	**DNC**
Astoria Generating Phase II[1]	NYC	550
Empire Generating CC[2]	EST	635
Greenidge 4[3]	WST	106
Westover 8[3]	WST	82

Notes:

1. The modeling for the July 2010 LEI report included the Astoria Generating CC II as announced new entry with a capacity of 740 MW. We have adjusted the capacity down to 550 MW to reflect the most recent proposed capacity rating.
2. The modeling for the July 2010 LEI report included the Empire Generating CC as announced new entry with a capacity of 350 MW, but electrically interconnected into the NYC zone. We have updated the capacity to 635 MW to reflect the plant's current capacity rating and aligned its electrical location.
3. These units will be placed onto protective lay-up status starting March 18, 2011 for at least a six month period, given the units are not economic based on the current and forecasted wholesale electric prices in UPNY. We chose to permanently retire these units because it is likely that these units will remain uneconomic given the potentially tightened environmental regulations and new wind addition in UPNY.

Sources: NYISO 2010 Gold Book, NYISO 2010 Reliability Needs Assessment, NYISO Planned Generation Retirements, NYISO Interconnection Queue and LEI analysis

3 LEI's modeling results for the 2018 test year analysis

3.1 Energy market impacts

As shown in the figure below, the regional price levels in the updated modeling are 11% to over 30% lower on average than those presented in the July 2010 LEI report due to decrease in fuel price and demand, for both Base Case and Project Case, and changes in resource mix.

Figure 7. Detailed comparison of ratepayer benefits in the 2018 test year modeling, as compared to the analysis in the July 2010 LEI report

2018	Updated @90%	Original @90%	Updated @75%	Original @75%
UPNY Consumption (GWh)	56,879	58,866	56,879	58,866
C-LHV Consumption (GWh)	32,721	32,948	32,721	32,948
NYC Consumption (GWh)	55,886	56,510	55,886	56,510
LI Consumption (GWh)	23,646	24,615	23,646	24,615
NYCA Consumption (inclusive of NYC) (GWh)	169,132	172,939	169,132	172,939
UPNY LMP, Base Case (Demand Weighted $/MWh)	$ 54.4	$ 61.1	$ 54.4	$ 61.1
C-LHV LMP, Base Case (Demand Weighted $/MWh)	$ 75.2	$ 110.9	$ 75.2	$ 110.9
NYC LMP, Base Case (Demand Weighted $/MWh)	$ 89.2	$ 120.9	$ 89.2	$ 120.9
LI LMP, Base Case (Demand Weighted $/MWh)	$ 91.4	$ 121.9	$ 91.4	$ 121.9
NYCA LMP, Base Case (Demand Weighted $/MWh)	$ 75.1	$ 98.8	$ 75.1	$ 98.8
UPNY LMP, Project Case (Demand Weighted $/MWh)	$ 54.4	$ 61.0	$ 54.4	$ 60.9
C-LHV LMP, Project Case (Demand Weighted $/MWh)	$ 73.8	$ 107.0	$ 74.2	$ 108.0
NYC LMP, Project Case (Demand Weighted $/MWh)	$ 80.2	$ 111.1	$ 81.6	$ 112.6
LI LMP, Project Case (Demand Weighted $/MWh)	$ 86.9	$ 113.8	$ 87.4	$ 115.0
NYCA LMP, Project Case (Demand Weighted $/MWh)	$ 71.2	$ 93.6	$ 71.8	$ 94.4
UPNY LMP Reduction (Demand Weighted $/MWh)	$ -	$ -	$ -	$ -
C-LHV LMP Reduction (Demand Weighted $/MWh)	$ 1.4	$ 3.9	$ 1.0	$ 2.9
NYC LMP Reduction (Demand Weighted $/MWh)	$ 9.0	$ 9.8	$ 7.6	$ 8.3
LI LMP Reduction (Demand Weighted $/MWh)	$ 4.5	$ 8.2	$ 4.0	$ 6.9
NYCA LMP Reduction (Demand Weighted $/MWh)	$ 3.9	$ 5.1	$ 3.3	$ 4.3
Ratepayer benefits (LMP Reductions), UPNY, 1,000 MW CH ($ million)	$ -	$ -	$ -	$ -
Ratepayer benefits (LMP Reductions), C-LHV, 1,000 MW CH ($ million)	$ 47	$ 130	$ 33	$ 97
Ratepayer benefits (LMP Reductions), NYC, 1,000 MW CH ($ million)	$ 501	$ 555	$ 427	$ 468
Ratepayer benefits (LMP Reductions), LI, 1,000 MW CH ($ million)	$ 106	$ 201	$ 94	$ 170
Ratepayer benefits (LMP Reductions), NYCA, 1,000 MW CH, NYCA	$ 654	$ 885	$ 554	$ 734

The CHPE project continues to create further price reductions. On a load-weighted system average basis, the CHPE project creates price reduction for NYCA of $3.9/MWh under the assumption of 90% utilization rate and $3.3/MWh under the assumption of 75% utilization rate for the 2018 test case.

Ratepayer benefits are a function of the price reduction and total energy consumption. Benefits are lower than what was presented in the original baseline, because of the lower demand assumptions in Gold Book 2010 as compared to Gold Book 2009. In addition, benefits are lower due to the overall market dynamics created by the change in key exogenous inputs, like fuel

prices, demand, and resource mix. The price change in UPNY is not statistically significant. However, C-LHV, NYC, and LI continue to experience significant price reductions as a result of CHPE. The total ratepayer benefit for NYCA in 2018 is therefore projected to range from $554 to $654 million, based on 75% and 90% utilization rates, respectively.

As reference, in our baseline, for the NYCA, we had estimated a ten-year annual average ratepayer benefit of $813.5 million. The 2018 specific annual benefit from the baseline totaled $885 million for the NYCA (assuming the 90% utilization rate). From the single-input sensitivities, the ten-year annual average benefit ranged from a low of $655 million to a high of $1.1 billion for the NYCA (these low/high points are associated with the fuel case sensitivities).

There are also incremental ratepayer benefits for New England, which we believe are in the range of $20 million to $25 million per annum (based on 2018 test year analysis). Our model does not report estimates of PJM LBMP impacts at this time.

3.2 Environmental impacts

LEI's 2018 test year analysis produced emissions reduction projections that are consistent with LEI's original results (baseline) and sensitivities. Specifically,, with a project utilization factor of 90%, LEI's original base case had a ten-year annual average estimate of 1,084 tons of NO_x avoided, 684 tons of SO_2 avoided, and 3.7 million tons of CO_2 avoided based on the generation resources in the NYCA. The 2018-speicifc figures in the original base case were slightly lower for reductions of CO_2.

Figure 8. Comparison of updated emission reduction vs. original Base Case emission reduction for NYCA, 2018 (tons)

Emission reduction (tons)	Updated @90%	Original Base @90%	Original Base @90% 10-yr average
SO2 (tons)	571	636	684
NOx (tons)	1,114	1,124	1,083
CO2 (tons)	2,940,413	3,578,541	3,682,731
Emission reduction (tons)	**Updated @75%**	**Original Base @75%**	**Original base @75% 10-yr average**
SO2 (tons)	454	407	526
NOx (tons)	952	953	909
CO2 (tons)	2,461,743	2,956,554	3,070,251

Source: LEI analysis

Figure 9. Comparison of emission reduction of CHPE project for NYCA in 2018 ($ millions)

Emission reduction	SO_2 (tons)	NOx (tons)	CO_2 (tons)
NYDPS Staff estimate	499 - 828	748 - 1,432	1.5 - 2.2 million
Updated ratepayer benefit with CHPE @ 75%- 90%	454 - 571	952-1,114	2.5 - 2.9 million

Source: DPS Staff analysis (January 14, 2011) and LEI 2018 test year analysis

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In the 2018 test year, LEI's analysis projects 1,114 tons of NO_x avoided 571 tons of SO_2 avoided, and 2.9 million tons of CO_2 avoided based on the generation resources in the NYCA when the project's utilization factor is 90%. At a project utilization factor of 75%, the emission reductions are slightly lower: SO_2, NO_x and CO_2 reductions are estimated at 407 tons, 952 tons and 2.5 million tons, respectively. With the exception of CO_2, DPS staff's upper bound estimates of SO_2 and NO_x reductions for the NYCA are higher than that estimated by LEI's 2018 test year analysis.

4 Appendix

Figure 10. Summary of energy market benefits under the original Baseline and sensitivities ($ millions)

	Ten-year average energy market ratepayer benefits (NYCA)
Baseline	$814
Low Fuel Price Case	$655
High Fuel Price Case	$1,099
Low Carbon Allowance Price Case	$790
2010 Gold Book Base Demand Case	$740
2010 Gold Book Low Demand Case	$690
2010 Gold Book High Demand Case	$880
75% Utilization Case	$690